Executive Office of Environmental Affairs
and
Water Resources Commission

WATER CONSERVATION STANDARDS

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CONTENTS

INTENT and PURPOSE of the Water Conservation Standards

The *Water Conservation Standards* (referred to as 'the Standards') set statewide goals for water conservation and efficiency, and provide guidance on effective conservation measures and incentives to meet the statewide goals identified in the Massachusetts Water Policy[1] (2004). The Standards also provide a vehicle to educate MA citizens about the importance of water conservation, its crucial link to our natural resources, and how all consumers can use water more efficiently. Water conservation is defined as any beneficial reduction in water loss, waste, or use, and water efficiency is defined as the accomplishment of a function, task, process, or result with the minimal amount of water feasible (Vickers, 2001). In this document the terms water conservation and water efficiency are used interchangeably.

The document includes both *standards* and *recommendations*. *Standards* are achievable, implementable, and practical measures that should be adopted by water suppliers, small and large water users, and state agencies in carrying out their water resources planning and management programs, and in issuing permits or approvals that involve water use. The Massachusetts Executive Office of Environmental Affairs (EOEA) seeks to encourage and support the adoption of *Recommendations* wherever possible. Although they may not be as widely achievable, implementable, and practical at the present time due to economic or technical reasons, they should be considered goals for the future and indicate the trend in responsible water use.

BACKGROUND

These Water Conservation Standards are a revision of the Water Conservation Standards adopted by the Water Resources Commission (WRC) on October 13, 1992. The goal of the 1992 Standards was to develop policies and specific recommendations to assist Massachusetts water suppliers in achieving the maximum possible water efficiency in their public water supply systems and to educate end users, homes, factories, and other places of business on conservation measures.

The 1992 Standards emphasized educating water suppliers and consumers on the importance of system efficiencies and conservation. A key tool was the development of local water conservation and resource management plans led by local conservation officials; and a key approach was to charge the full cost of water to consumers and develop enterprise accounts. Subsequently, the Water Management Act program at Massachusetts Department of Environmental Protection (MassDEP) used the Standards as conditions on its water volume permits, and the WRC used them in reviewing interbasin transfer applications. The 1992 Standards were also fundamental to the 2001 Interbasin Transfer Act Performance Standards and have served as a benchmark for reviewing conservation efforts statewide.

The statewide Water Policy developed by EOEA in 2004 identified the revision of the Standards as a crucial step in moving forward with water resources planning to sustain the economic and environmental value of our water resources. Water Conservation is an essential component of a comprehensive effort to ensure that there will be sufficient water available now and in the future to meet the needs of humans as well as natural communities.

[1] http://www.mass.gov/envir/wptf/publications/mass_water_policy_2004.pdf

INTRODUCTION

Massachusetts has been a leader in the field of water resources protection, including water conservation and efficiency. On an average annual basis, Massachusetts has one of the lowest per capita residential demands in the country. The state is home to the Massachusetts Water Resources Authority (MWRA), which in the 1980s developed a highly successful water conservation program that resulted in dramatic reductions in their water supply system demand. Those gains have been sustained to this day. Many communities outside the MWRA distribution system have also made investments in water conservation and efficiency that have resulted in reductions in per capita demand and water supply system efficiency.

Despite these improvements, significant opportunity exists for greater water use efficiency that will generate economic, public health, and environmental benefits. Many water suppliers are finding it increasingly difficult to meet essential public water supply needs for drinking, bathing, cooking, and fire protection.
Water use on a per capita basis varies widely from community to community and also from season to season, and data show that there remains great opportunity for improved efficiency in water systems and water use by consumers.

Massachusetts' economy is inextricably linked to its natural resources, water being a critical one. The Commonwealth receives an average of 44 inches of rainfall each year - an amount many consider to be plentiful compared to other areas of the country. However, the rainfall is seasonal and only a portion of the precipitation is available for human use. It is also important to recognize that Massachusetts is one of the most densely populated states in the nation with over six million people living on slightly more than six million acres of land. In fact, the per capita water availability is significantly less than some desert states, such as Nevada. Hence, Massachusetts' current water use and future growth and development needs to be within these constraints.

Furthermore, the Commonwealth's native flora and fauna rely upon the relative abundance of water in our natural environment. Our native aquatic and riverine organisms show a considerable degree of resiliency, surviving naturally-occurring low-flow periods that result from extended periods without precipitation. However, human activities (such as streamflow-depleting water withdrawals especially during natural low flow periods, and increases in impervious surfaces) can increase the duration, frequency and/or severity of low-flow conditions beyond natural levels. Placing streams under chronic unnatural low-flow conditions can cause substantial harm to aquatic and other water-dependant organisms and habitats, and ultimately to our economy and quality of life through loss of scenic, recreation and property values.

Massachusetts, therefore, continues to have an obligation to emphasize water-use efficiency to:

1. Preserve the Commonwealth's water resources, as part of the public trust;
2. Sustain current and future water needs;
3. Protect aquatic ecosystems and minimize water supply impacts; and
4. Provide financial savings in the cost of water.

The following addresses each of these four obligations:

1. Preserve the Commonwealth's Water Resources, as Part of the Public Trust

The Massachusetts Water Resources Commission (WRC) has outlined the State's interest in protecting water resources as public resources to be held in trust for current and future generations, as follows:

> "Water is a valuable resource of the Commonwealth, and as such, the state needs to establish laws and policies to provide for its multiple uses, protect its quality and ensure that it is available to meet the legitimate needs of its citizens. The state's overall goal is to ensure that water is available in sufficient quantity and quality to meet Massachusetts' current and future needs and to accommodate both consumptive and non-consumptive needs." (WRC, 1984)

Water resources science and policy have evolved considerably since 1984 and today there's an increased emphasis on demand management as an essential component of the effort to ensure the sustainability of our water resources.

2. Sustain Current and Future Water Needs

Although Massachusetts receives relatively abundant rainfall and has numerous rivers, lakes and ponds, many cities and towns have found themselves facing water shortages. Water suppliers increasingly find new source development difficult due to a variety of constraints including cost, time needed, environmental impacts, regulatory requirements and an increasing scarcity of suitable sites. Finding new water by investing in efficiency and demand management is almost always more cost-effective than developing a new source[2]. Demand or system management through programs such as leak detection, metering, and reductions in indoor and outdoor use, has the additional benefit of causing no environmental impacts- unlike developing new water sources. Water savings that result from increased efficiency can, in effect, serve as a new water source. Efficiency should be given priority over new source development, with the understanding that in some cases new water supply sources will be needed to accommodate new growth and/or to offset localized environmental stress or other factors.

3. Protect Aquatic Ecosystems and Minimize Water Supply Impacts

In addition to meeting the growing demand for water for human use and consumption, nonconsumptive uses must also be protected. These include aquatic habitat for wildlife, flow, temperature-dependent fisheries such as brook trout, and water-dependent recreation such as paddling, fishing, and swimming. Some areas of Massachusetts are experiencing environmental impacts related in part to drinking water withdrawals including deterioration of water quality, loss of stream flow, loss of habitat, and disruption of connection between habitats[3]. Water taken from aquatic systems for public water supply is only one component of the water balance. However, it can be a substantial one, especially if the greatest water demands are occurring during the summer season, or during extended droughts, when water is least available in the natural environment. Dams, diversions and export of wastewater from our river basins can also place significant stress on aquatic ecosystems and alter the streamflow and hydrology in our watersheds. Water savings that result from increased efficiency can protect and mitigate the impact of withdrawals, and restore balance to the stressed natural systems.

[2] That said, it is possible for a new water supply source to have a net environmental benefit if it replaces or mitigates an existing source that causes adverse ecological impacts (such as eliminating or reducing pumping from an existing shallow streamside well that desiccates an adjacent stream).

[3] For examples of observations of streams with unnaturally low- or no-flow conditions please see the Riverways' Low Flow Inventory at: http://www.mass.gov/dfwele/river/rivlow_flow_inventory/home.html

4. Provide Financial Savings in the Cost of Water

Increasing water use efficiency can provide an economically competitive advantage for public water suppliers and businesses by reducing operating and maintenance costs (lower electrical power costs and reduced chemical costs for water treatment), reducing wastewater treatment costs, freeing up plant capacity for pumping and treatment of water and wastewater, and avoiding the considerable cost of investing in new sources of water. Individual residents, businesses, and the public sector save significantly by decreasing their water use. Greater water efficiency can also delay, avoid and restrain capital costs to develop, treat and convey additional water, and reduce needed wastewater treatment capacity. Finally, increased water efficiency can reduce operating and maintenance costs for Public Water Systems by lowering electrical power and chemical costs, and reducing plant capacity for pumping and treatment of water and wastewater.

Summary

Water use efficiency is critical to ensuring the long-term sustainability of water supplies and in balancing consumptive and instream uses. Water use efficiency is becoming increasingly important as water demand rises. It is a crucial factor in sustaining the economic health of the State and continued vitality of the region. Its great promise resides in the idea that increasing knowledge, sophistication, technology and care can save substantial volumes of water and increase the productivity of each unit of water that is used.

IMPLEMENTATION of the WATER CONSERVATION STANDARDS

The standards and recommendations should be used in all programs affecting the planning and management of the Commonwealth's water resources, including the Water Management Act, the Interbasin Transfer Act, the Commonwealth Capital Application, and the Ocean Sanctuaries Act. In addition, water use efficiency standards should be included in all construction, rehabilitation, and facility development activities statewide.

OVERVIEW of the STANDARDS and RECOMMENDATIONS

There is a role for everyone in water conservation and efficiency efforts. Significant levels of water conservation are unlikely to be achieved by a water supplier acting alone. All segments of the water-using community need to do their part to understand and support the need for water conservation and encourage water-saving practices on an individual and community level. The following standards and recommendations are intended for adoption statewide by all water suppliers and users, including individual consumers, businesses, industries, and public agencies. The standards and recommendations cover key areas of water supply planning and management, and indoor and outdoor water use, including the following ten topics:

1. Integrated Planning
2. Water Audits and Leak Detection
3. Metering
4. Pricing
5. Residential Use
6. Public Sector Use
7. Industrial, Commercial and Institutional Use
8. Agricultural Use
9. Lawn and Landscape
10. Public Education and Outreach

The goals of the standards and recommendations are to:

1. Integrate water conservation and efficiency measures into all aspects of water supply planning and management;
2. Maximize the efficiency of public water supply system operations by conducting regular water audits; using the best available technology to perform regular leak detection as recommended through audits; promptly repairing leaks; metering all residential, industrial, commercial, institutional, agricultural and municipal users of water supply systems; and practicing full cost pricing;
3. Reduce indoor/outdoor water use by setting efficiency standards that are specific and measurable, and recommending options to meet or exceed those standards. Specifically, to decrease average residential water use to 65 residential gallons per capita per day (rgpcd) or lower or have the community implement a comprehensive water conservation program that makes a good faith effort to reach 65 rgpcd average water usage target;
4. Emphasize and implement water conservation in government buildings and facilities to accurately account for water use and to demonstrate water saving techniques and concepts to the public;
5. Maximize efficient outdoor water use so that outdoor water use from the potable public water supply comprises only a small portion of total water use, with a long-term goal of further reducing demand through reliance on alternative irrigation sources (e.g., rainwater harvesting and reclaimed wastewater) and water-wise landscaping techniques; and
6. Promote public awareness of the long-term economic and environmental benefits of conserving water to build public support for all aspects of water conservation and efficiency, and to influence behavior to maximize conservation by individuals and institutions.

In the document the term “water supplier” refers to public water suppliers, private water suppliers, and water districts; and the term “communities” refers to cities and towns.

1.0 Integrated Planning

Several components impact a watershed's hydrological cycle - water withdrawals, wastewater and stormwater. Together, these components can have a tremendous influence on the quantity and quality of water. An integrated approach is needed to keep water local and to begin to address and mitigate any hydrological imbalances that result. Water conservation is a major component of this approach. Planning for future upgrades, development and/or expansion of water infrastructure within a community must take into consideration the interdependence of these three components.

Several guidance documents are available to assist communities with an integrated approach to water resources planning. These include guidance for developing the Local Water Resources Management Plan (Appendix B of the Interbasin Transfer Act Performance Standards[4], WRC), and the Integrated Water Resources Management Plan (MassDEP).

The Local Water Resources Management Plan, required by the WRC for all communities that have gone through the Interbasin Transfer Act approval process, can provide a framework for implementing these Standards and establishing long-term priorities and plans for system maintenance, source protection, and, as necessary, new source development. The goal of the plan is to integrate water supply and wastewater planning at the community, water or sewer district, or water or sewer authority level.

Communities with severe problems may benefit from an Integrated Water Resources Management Plan (IWRMP). Components of an IWRMP may be triggered by MEPA, or Interbasin Transfer Act. The Wastewater State Revolving Fund also encourages integrated water resources planning. The IWRMP may encompass an assessment of a community's existing water supply, wastewater and stormwater practices and the impacts of these on the water balance in the watershed. It also identifies future needs and evaluates alternative approaches to meet those needs. Guidance for the IWRMP is available at http://www.mass.gov/dep/brp/mf/files/wwtrfpg.pdf (Note: Currently, this guidance addresses *only* wastewater and is called the 'Comprehensive Water Resources Plan. The Integrated guidance with the three above components is expected to be released by MassDEP in Spring 2006.).

Drought/emergency management plans are another important component of water supply and demand management programs. Each public water supplier should have a written plan to respond to emergencies – both naturally-induced and man-made. A demand management plan which incorporates seasonal water use strategies is important to assist water suppliers to meet high seasonal demands without putting excessive strain on the water supply and distribution system or on the environment (as described in Section 9.0, Lawn and Landscape).

Standards

As part of an integrated planning effort:

1. Develop strategies appropriate to the system to reduce daily and seasonal peak demands and develop contingency plans to ameliorate the impacts of drought, seasonal shortages and other non-emergency water supply shortfalls. Develop a drought management plan that follows American Water Works Association Drought Management Planning guidance (AWWA, 1992).
2. Develop emergency management plans as per MassDEP requirements (MassDEP Policy 87-05 - Declaration of a State of Water Supply Emergency - or the latest available version).

[4] http://www.mass.gov/dcr/waterSupply/intbasin/docs/finalps.doc

3. Develop a written program to comply with these Conservation Standards and, where possible, with the recommendations outlined in this document, in the operation and management of the water supply systems. (Note: Those complying with their Water Management Act permit will meet this requirement)
4. The above documents should be readily available to personnel from all municipal departments to facilitate compliance and, if necessary, enforcement.

Recommendations

1. **Integrated Planning.** Infrastructure planning evaluations within communities should include water supply, wastewater and stormwater with greater emphasis on the issue that is most problematic. Planning should either follow a) the MassDEP guidance for Intregated Plans or b) the Water Resources Commission guidance for a Local Water Resources Management Plan. The plans should be updated periodically. Specific principles that should be considered include the following:

    - **Stormwater.** Stormwater is often a significant component of the water budget and influences the amount of water transported away from a subbasin. The MA Water Policy includes a recommendation to "Promote stormwater recharge close to its site of origin". Integrated planning efforts should recognize stormwater as a resource, especially with regards to its potential for providing recharge to the hydrologic system through infiltration or controlled surface water replenishment designs. As recommended in the Water Policy, communities should reduce the amount of impervious surface in new development and use Low Impact Development (LID) techniques to control stormwater runoff and increase recharge[5].

    - **Wastewater.** Infrastructure often transports wastewater out of its basin of origin, thus disturbing the water balance and depleting local streamflow and groundwater. To mitigate this, options such as decentralized treatment plants, and recharge and reuse should be strongly considered. The MA Water Policy includes a recommendation to "increase treated wastewater recharge and reuse" and states that, "Infiltration and recharge of water and treated wastewater into the ground will help replenish aquifers, enhance riverine base flows, and maintain healthy flow levels even in high demand summer months." Per recommendations in the water policy, communities should consider use of reclaimed water for ballparks, golf courses, and other recreational irrigation, as well as for large-scale development projects.

    - **Infiltration and Inflow (I/I).** Infiltration is defined as groundwater that enters the collection system through physical defects such as cracked pipes/manholes or deteriorated joints. Typically, many sewer pipes are below the surrounding groundwater table, therefore leakage into the sewer (infiltration) is a broad problem. Inflow is extraneous flow entering the collection system through point sources. Inflow may be directly related to stormwater runoff from sources such as roof leaders, yard and area drains, sump pumps, manhole covers, cross-connections from storm drains or catch basins. Inflow may also be contributed from non-storm related point sources, such as leaking tide gates, cooling-water discharges, or drains from springs and swampy areas (Infiltration/Inflow Task

[5] Low Impact Development (LID) is an approach to stormwater management, which encourages ground water infiltration, runoff detention and filtration. LID techniques infiltrate and filter stormwater at the lot level, instead of conveying the water away from the project. The primary tools of LID are landscaping features and naturally vegetated areas which encourage detention, infiltration and filtration of stormwater on site. Other tools include water conservation, use of pervious surfaces, maintaining existing vegetated areas and minimizing disturbed areas. The national LID manual (Low Impact Development Design Strategies: An Integrated Design Approach) can be found on the EPA website at: http://www.epa.gov/owow/nps/lid/. Also see the state website for more information at: http://www.mass.gov/envir/lid/default.htm

Force Report, March 2001). I/I removal plays an important role in balancing the water budget by minimizing the amount of groundwater and stormwater lost into wastewater systems. As applicable, communities should strive to implement the seven overall goals approved by the I/I Task Force. They are as follows:

- Eliminate all sewer system backups
- Minimize, with a long-term goal of eliminating, health and environmental impacts of sewer system overflows related to I/I
- Remove all (and prevent new) inflow sources from separate sanitary systems
- Minimize system-wide infiltration
- Educate and involve the public
- Develop an operation and maintenance program
- Improve funding mechanisms for identifying and removing I/I

- **Water Supply**. Water supply development, whether for residential use, industrial use, development, irrigation or fire protection, needs to be within the water budget of the local basin. In many cases, water is moved via infrastructure from one basin to another, thus dewatering one basin in order to support another. This can lead to low streamflows, habitat and other ecological problems in the donor basin. Ideally, the water should be used, discharged locally so as to create the least amount of disturbance to the water balance and the local ecology, and recharged whenever possible. In cases where transport of water across basin lines is required, alternatives must be considered. The preferred alternative would be one that provides the most environmental, time and cost-sensitive option.

2. **Communicate with other local officials**. To aid in community planning and decision making, water suppliers should keep local officials (Conservation Commissions, Zoning and Planning Boards, Selectmen, and other agencies concerned with development) regularly informed of water consumption and supply availability.

3. **Water Banks**. Communities and water suppliers, especially those prone to capacity problems or experiencing significant growth, should consider establishing a Water Bank. The purpose of a Water Bank is to provide a water supplier with required resources to maintain or reduce existing demand, while accommodating the water needs of existing and/or future development. For example: A water bank could require that anyone seeking to connect to the municipal water supply must reduce from the existing water supply system or end users at least two gallons for every new gallon proposed to be used by the new development. For further information on water banks, see Appendix A.

2.0 System Water Audits and Leak Detection

Water audits provide water suppliers with an effective means of reducing water and revenue losses and make better use of water resources. The overall goal of the water audit is to help the public water supplier select and implement programs to reduce distribution system losses. In addition to water audits, regular leak detection survey programs provide critical information on system water losses and are an essential component of system management. Detecting and fixing leaks can provide one of the largest returns on investment, especially in older systems.

An important measure of system efficiency is the volume of unaccounted-for-water (UAW). UAW is defined as the residual resulting from the total amount of water supplied to a distribution system as measured by master meters, minus the sum of all amounts of water measured by consumption meters in the distribution system - and minus confidently estimated and documented amounts used for certain necessary purposes as specified by the MassDEP.

Examples of UAW include, but are not limited to: leakage, meter inaccuracies (unless they fall under the category of source meter calibration which allows for adjustment per results of source meter calibration required in the MassDEP's Annual Statistical Report (ASR) audit), errors in estimation of stopped meters, unauthorized hydrant openings, illegal connections, data processing errors, and undocumented fire fighting uses.

Certain necessary uses specified by MassDEP that can be confidently estimated and documented in writing can be excluded from the calculation of UAW. These include: storage tank overflow and drainage, water main flushing and flow testing, fire fighting, bleeding or blow-offs, sewer and stormwater system flushing or cleaning and street cleaning. Generally, leakage is classified as UAW; however, individual water main breaks can be discounted on a case-by-case basis.

All public water suppliers are required to calculate UAW as part of the ASR submittal to MassDEP. The most recent ASR data from 2004 show UAW ranging from zero to 41%, with an average of 13% for 220 reporting communities. The "industry standard" for UAW ranges from 10% to 15%, depending on the reference consulted. It is important to note that for many public water systems, a significant portion of UAW is not water that is wasted, misused or lost, but water that may be used for legitimate purposes but is not accurately measured, or measured at all.

Standards

1. Conduct the ASR water audit on an annual basis using the MassDEP Water Audit Guidance Document (http://www.mass.gov/dep/water/approvals/wmgforms.htm#audit).
2. Conduct complete system-wide leak detection every two (2) years unless:
   - The results of the ASR water audit indicate that leakage constitutes a small portion of the system's unaccounted-for water; or
   - The volume of leaks detected through the most current leak detection survey (conducted within the previous two years) indicate insignificant leakage.

   In these cases, the water supply system should work with the regulatory agency (ies) to develop a more efficient schedule for leak detection.
3. Conduct field surveys for leaks and repair programs in accordance with the AWWA Manual 36, and any MassDEP guidance documents.
4. Repair all leaks found as expeditiously as possible. Each community shall establish a priority system to implement leak repairs. Leaks causing property damage or affecting public safety should be fixed immediately. Further guidance is referenced in recommendation 3 below.
5. Recognize water audits and leak detection and repair as expenses of the water supply system and include them in a full-cost pricing structure and annual budget.

Recommendations

1. **Comprehensive Water Audit.** Conduct a comprehensive audit every 5 to 10 years depending on the findings of the ASR audit. A comprehensive audit is strongly recommended for communities/systems showing significant and unexplainable increases in UAW from one year to the next, and communities/systems that are consistently unable to meet regulatory standards for UAW.
2. **System Assessment.** To help eliminate and prevent leaks and water loss, water suppliers should perform assessments of their systems on a regular basis to determine where capital improvements are appropriate and incorporate the recommendations into a long-term capital improvement program. Specifically, aged and undersized or structurally deteriorated pipe should be replaced, and structurally sound pipe should be cleaned and lined to ensure its long term structural integrity.
3. **Guidance for leak repair.** Communities looking for more specific guidance on timelines for repairing leaks should refer to the following:
   - MWRA regulations, 360 CMR 12.09: Leak Repairs
   - MassDEP guidance (http://www.mass.gov/dep/water/approvals/wmgforms.htm#audit)
4. **Leak Detection Services**. Communities should consider pooling resources to procure leak detections services, similar to the MWRA program that procures a leak detection consultant for a three-year period and makes the consultant services available to customer communities on a task order basis. The three-year procurement includes pricing for a larger volume of service (about 5000 miles of water main) than would be procured by any one community (typically individual community systems are 100 – 200 miles of water main).
5. **Establish fines for stealing water.** Those with authority to set and enforce civil penalties for theft of public water (including but not limited to municipal Water Commissioners, Town Selectmen and public water suppliers; not including private water suppliers) should develop a new bylaw/ordinance or amend existing bylaws/ordinances to establish a civil penalty by providing authority to levy a significant fine, that may be enforced criminally or non-criminally. Example language from a recent bylaw passed in East Bridgewater, MA is included in Appendix B.
6. **Pressure reduction.** The MA plumbing code (248 CMR 10.14 (g) Excessive Water Pressure) requires that a pressure reducing valve be installed on the water service connection to a building when the pressure is eighty (80) pounds per square inch (psi) or greater. Community water suppliers should evaluate existing water system regulations in order to ensure compliance with this regulatory requirement. This evaluation could include the establishment of minimum pressures for users as a conservation measure. Conservation of water use may be obtained through reduced pressure of plumbing fixtures.

3.0 Metering

Complete system metering informs both the supplier and the customers of how much water they are using, provides the supplier with valuable knowledge of customer use patterns, assists in demand management programs, and enables the supplier to bill the customer more accurately and fairly based on actual use. Complete system metering also provides essential data for managing water resources state-wide. With accurate knowledge about current water use, the supplier can more effectively identify potential water savings and assist specific users to implement water saving measures, thereby providing the opportunity to reduce overall system demand and free up water that may be needed by new customers, or enable the retention of more water in the natural environment. In addition, full and accurate metering means that the water supplier can be paid for all the water they provide, without lost revenue from unmetered or inaccurately metered water.

Standards

1. Ensure 100% metering- All water distribution system users shall have properly sized service lines and meters that meet AWWA performance standards.
2. Implement a water meter repair/replacement policy and program. The program should replace meters by size and time based on AWWA standards and guidelines available on the MassDEP website (link). Suppliers should establish an annual budget line item for the calibration, replacement and repair of all sources of supply and distribution network water metering systems.
3. Seal all water account metering systems against tampering and periodically inspect to ensure water works system integrity.
4. Calibrate any meter used to record quantity, according to its type and specification. The AWWA Standards can be consulted for calibration requirements and accuracy standards. Time periods for calibration are generally based on meter size. The following schedule should be followed:

METER SIZE	TIME PERIOD	METER SIZE	TIME PERIOD
5/8 inch of less	10 years	3 inches	3 years
¾ inch	8 years	4 inches	2 years
1 inch	6 years	6 or greater inches	1 year
1.5 to 2 inches	4 years	Venturi meters	2 times a year

Recommendations

1. **Funding for meter replacement.** The State should make financial assistance available for meter replacement and automatic meter reading equipment.
2. **Increase billing frequency.**
   - **Quarterly billing for domestic accounts.** For domestic accounts quarterly billing is recommended, and customers should be billed on actual, not estimated, meter readings. A quarterly billing frequency (versus annual or biannual) helps customers keep better track of their water usage, take note of seasonal variations or potential leaks, and make adjustments in their water use accordingly.
   - **Monthly billing for large users**. Meter reading and billing for the largest users should be done monthly.
   - See Section 4.0 Pricing for additional recommendations on billing.
3. **Remote reading**. Communities/water suppliers should consider investing in a meter reading system that allows remote reading of meters and regular billing to maximize cash flow, utilize employees efficiently, and enable users to track their water use.
4. **Municipal control of commercially sized meters**. Water Suppliers should establish the necessary regulations and controls to ensure that owners of large meters (6 inches or greater) calibrate those meters annually and the results are provided as part of an annual reporting requirement.
5. **Minimize use of estimated data**. Meter reading should be done in a manner that allows for actual data instead of estimated data for ASR reporting.

4.0 Pricing

Consumers should be charged the full cost of water. Full-cost pricing refers to price levels which recover all the direct and indirect costs associated with providing water, as outlined below in standard 1. Full cost pricing can take the form of any rate structure, so long as all costs are recovered through prices.

The price of water can be an important demand management tool if set properly. Studies have shown that water demand can be manipulated by price to some degree. Water for necessities (sanitation, cleaning, and cooking) is far less responsive to price than water for more discretionary uses (lawn watering, car washing, and swimming pools).

Rate structures can be categorized as being conservation-oriented (likely to promote conservation), conservation-neutral (neither promoting nor discouraging conservation), or discouraging conservation. The general types of conservation pricing options are:

- Increasing block rates
- Seasonal rates, and
- Repeal of volume discounts (i.e. eliminating decreasing block rates) (Stallworth, EPA 832-F-03-027)

Of these three categories, charging a higher unit price as consumption rises (i.e. increasing block rates) is the most popular form of conservation pricing. Seasonal rates, where prices rise and fall according to water supplies and weather conditions (with higher prices usually occurring between April and October), are used less often (Stallworth, EPA 832-F-03-027). The AWWA's 1998 survey of residential rate structures of 827 utilities shows that approximately 22% of the utilities employ increasing block rates and 2% employ seasonal rates.

For effective pricing, water suppliers, communities, and water planners need to consider at a minimum the following three issues: the service population's ability to afford higher rates, the effects of conservation rates on a utility's revenues, and their actual effectiveness in reducing water demand (Stallworth, EPA 832-F-03-027). Further guidance on these three concepts - affordability, revenue stability, and effectiveness - is provided in EPA and AWWA pricing guidance documents referenced below.

A variety of different rate structures are used throughout Massachusetts- some are conservation-oriented while others are not. Based on results of a 2004 Tighe & Bond survey of Massachusetts communities:

- 48 % use an ascending rate structure
- 46 % use a flat rate structure
- 5 % use a flat fee, and
- less than 2 % using descending rates*

*Note that for public water supplies descending rates are currently not permitted without legislative approval under Massachusetts General Laws Chapter 40: Section 39L. Private water supplies regulated by the Department of Telecommunications and Energy are not currently subject to this law, but legislation has been filed to include private supplies under the law.

Billing is another important component of operations that provides an opportunity to enhance conservation if implemented effectively. Billing at a frequency that provides customers the opportunity to regularly evaluate and adjust their usage, is preferable. Of the Tighe & Bond survey respondents:

- 47 % use quarterly billing
- 45 % use a biannual billing cycle
- 5% use a monthly billing cycle, and
- 3 % use either an annual, bimonthly, or tri-annual frequency

In addition to billing frequency, the ease of understanding a bill, and the educational value of the bill are also important aspects for promoting conservation, as outlined in recommendation 3.

Standards

1. **Full Cost Pricing.** Communities and water suppliers should establish a water pricing structure that includes the full cost of operating and maintaining the water supply system. They should perform a rate evaluation every three to five years to adjust costs as needed. Full cost pricing factors all costs - operations, maintenance, capital, and indirect costs (environmental impacts, watershed protection) - into prices. Full cost pricing can take the form of any of the rate structures included below, so long as all costs are recovered through prices. A full cost water pricing structure includes, but is not limited to the following:
   - A water conservation program including but not limited to:
     - Purchase and installation of water conservation/retrofit devices and rebate programs to promote their adoption in the service community;
     - All aspects of a public education program including purchase and distribution of educational materials and related staff time;
     - Leak detection and repair, and water audits; and
     - Metering and billing, including a meter replacement/repair program.
   - Hiring staff to run all aspects of the water supply system, staff benefits package, and staff training and professional development
   - Pumping, maintenance, electricity/fuel
   - Treatment and associated treatment plant costs
   - Distribution system operation, repair, and maintenance
   - Watershed land purchase/protection, well site purchase/protection, aquifer land acquisition
   - Capital replacement fund, capital depreciation account, and debt service

2. **Prohibit decreasing block rates.** Decreasing block rates which charge lower prices as water use increases during the billing period, are not allowed by M.G.L. Chapter 40: Section 39L. Although this law does not cover private companies that are regulated by the DTE, MassDEP will include a provision requiring the filing of a rate adjustment application with DTE in any permit issued to a private company. This rate adjustment application shall propose either a flat or increasing block rate structure. DTE must then consider the application and issue a determination directing the Company to implement either a flat or increasing rate structure unless the company has adequately supported reasons why this should not occur.

Recommendations

1. To promote water conservation, communities and water suppliers should consider rate structures which encourage reduction of water use for nonessential water uses. Generally nonessential uses are defined as those activities not required: (a) for health or safety reasons; (b) by regulation; (c) for agricultural production (d) for the maintenance of livestock; or (e) to meet the core functions of a business. Those with responsibility for setting rates must consider the impact of adopting seasonal and increasing block rates on those users who may fall into one of the above categories. It may be more appropriate to develop a separate rate category for other classes of users (i.e. "essential"), which takes into account the legitimate essential water uses, but still provides for water conservation.

   The following rate structures may be appropriate to reduce non-essential water use:
   - **Increasing block rates.** Increasing block rates or tiered pricing encourages reduced water use by increasing the per-unit charges for water as the amount used increases. The first block is charged at one rate, the next block is charged at a higher rate, and so forth. The price difference between blocks is very important in influencing the customer's usage behavior. If the difference in cost between blocks is too small, it will not provide the incentive to conserve at the higher block rate.

- **Seasonal rates.** Seasonal rates are set according to water demands and weather conditions. There are a variety of approaches including establishing increasing block rates only during the summer months (May 1 to September 30th when demand is often higher) or having a year round block rate structure with higher block rates during the summer months. [6]

2. **Avoid flat fees and uniform rate structures if set too low**. Communities and water suppliers should avoid flat fee rates, and uniform rate structures that are set too low to encourage conservation. These types of rate structures are generally not effective in encouraging conservation.
   - **Flat fee rates.** Flat fee rates do not vary by customer characteristics or water usage.
   - **Uniform rates.** A uniform rate charges the same price per unit for water usage beyond the fixed customer charge, which covers some fixed costs. Note: If prices are high enough, uniform rates can encourage conservation.

3. **Billing**
   - The rate structure should be clearly indicated on the water bill.
   - Billing should be carried out at least quarterly.
   - The cost of reading and billing should be shared between the water and sewer operations where applicable.
   - Utilities should move toward adopting billing software that allows customers to compare their individual water use for the last 12 months, and compare their water use with average water use for their customer class.
   - Water use should be reported in gallons and a table for looking up daily water use (i.e. residential gallons per capita per day, rgpcd) should be provided for ease of understanding and to promote efficient water use behavior (see table in Appendix C).
   - Water bills could include an automated "thanks for conserving water" message where usage drops over the comparable period last year, and a "please do what you can to conserve water" message for users whose water use increased over the same time period.
   - In communities with Automatic Meter Reading systems, set up a web site to provide secure access to water use data by customers and water auditors.

4. **Enterprise Accounts.** It is recommended that the water supplier establish an enterprise account for water in accordance to Massachusetts General Law, Chapter 44: Section 53F 1/2 Enterprise Funds. http://www.mass.gov/legis/laws/mgl/44-53f.5.htm

5. **Develop a methodology to assess environmental costs.** EOEA should commit to developing a methodology for assessing the environmental costs of water withdrawals for water suppliers to use in setting "full cost" water prices.

[6] For more information on developing conservation-oriented rates, see:
- "Water Conservation-Oriented Rates" (The American Water Works Association, 2005) http://www.awwa.org/bookstore/product.cfm?id=20562
- The US EPA homepage on Water and Wastewater Pricing: http://www.epa.gov/water/infrastructure/pricing/index.htm
- "Water and Wastewater Pricing, An Informational Overview" (US EPA Office of Water and Wastewater Management EPA 832-F-03-027) http://www.epa.gov/water/infrastructure/pricing/PDF/waterpricing_final2.pdf
- "American Water Works Associations' Manual of Water Supply Practices: Water Rates Structures and Pricing" (AWWA M34).

5.0 Residential

As over sixty percent of the public water supply in Massachusetts is residential use, any improvements in residential water conservation and efficiency will result in significant water savings. Residential water use is comprised of indoor and outdoor water use. Indoor use typically includes toilets, clothes washers, showers, faucets, dishwashers, and other domestic uses including cleaning and cooking. National average indoor water use for a nonconserving and a fully-conserving single family home in North America are presented in Table 1, Appendix D. Outdoor water use can include irrigation of lawns and gardens, filling and refilling swimming pools, car washing and other cleaning. Leakage within the consumer-owned portion of the water system can be an additional and sometimes substantial component of indoor and outdoor water use.

Standards

Standard 1 applies to indoor water use only; Standard 2 includes both indoor and outdoor use. Additional standards for outdoor residential water use related to lawns and landscapes are presented in Section 9.0 Lawn and Landscape.

1. **Install Water Efficient Plumbing Fixtures.** Communities must meet the standards set forth in the Federal Energy Policy Act, 1992 and the Massachusetts Plumbing Code (Table 2, Appendix D). Retrofit programs should include low-flow showerheads, faucet aerators, low-flow toilets, toilet leak detection kits, and educational literature about installation and water conservation savings (in gallons and dollars). Programs that include low-flow toilets should consider the new High Efficiency Toilets, including "dual flush" toilets widely used in Europe, as well as power-flush models that use a maximum of 1.28 gallons per flush (gpf) and offer significant water savings over the now standard 1.6 gallon models.
2. **Meet Efficiency Goals for Residential Water Use.** With consideration of the caveats listed below, and based on review of residential water data from statewide reports and national studies (Appendix B), this document establishes the following goal for residential water use efficiency:
   - All communities must strive for residential gallons per capita per day (rgpcd) of 65, including both indoor and outdoor use[7].
   - If a community's rgpcd is greater than 65, that community should be implementing a comprehensive residential water conservation program. The program should seek to reduce residential indoor and/or outdoor water use by implementing some or all of the applicable recommendations below, and in Section 9.0, Lawn and Landscape. The scope of the program will be specific to circumstances in each community and the recommendations are provided as a menu of options. If a community's rgpcd is at or below 65 that community should continue with efforts to remain at that level.

   Caveats: The State recognizes the existence of the following conditions in Massachusetts that affect communities' efforts to lower their rgpcd to meet or exceed benchmarks set forth in these standards:
   - In certain cases, local conditions may prevent a community/water supplier from fully meeting these standards, even after a substantial effort has been made. Examples include, but are not limited to:
     - Older communities limited by an aging infrastructure and a greater proportion of inefficient plumbing fixtures and appliances in their existing housing stock. These characteristics may require both a longer time period and greater financial assistance to meet water conservation standards.
     - Economically disadvantaged communities, which have budget constraints, may require both a longer time period and greater financial assistance to meet water conservation standards.

[7] While some may argue that one size does not fit all, efficient water use can and has been scientifically measured and estimated, and these studies and data allow us to set a goal that represents a high level of efficiency for both indoor and outdoor water use. Many Massachusetts communities have already achieved 65. By setting a goal that falls just below our current statewide average of 69 (DEP, 2003 ASR), these standards set a strict but realistic benchmark based on the best available data.

- Communities with large seasonal populations may have difficulty accurately estimating rgpcd. These communities should be implementing a comprehensive residential water conservation program including both indoor and outdoor water use components.

In these cases, the water supplier should document any efforts that have been undertaken in order to comply with the standard.

Recommendations

Recommendations apply to indoor water use and outdoor water use that is not related to lawn and landscape maintenance. Recommendations for outdoor residential water use related to lawns and landscapes are presented in Section 9.0 Lawn and Landscape.

1. **Promote Water Efficient Household Appliances.** Water Efficient Household Appliances (especially clothes washers) provide an opportunity for significant water (and energy) savings (Table 1, Appendix E). State and municipal officials should take the lead with professional organizations in implementing the following five strategies to achieve this recommendation.
   - **Update the State Plumbing Code.** The State should include efficiency standards for household appliances in the plumbing code and should update existing plumbing fixture standards to reflect current designs that allow for greater water use efficiency.
   - **Create tax incentives for installation of water efficient appliances.** The State should work with partners to develop and pass legislation that provides a sales tax exemption on the purchase of qualified water-efficient toilets and washing machines.
   - **Provide rebates for water efficient fixtures and appliances.** Water suppliers should consider providing customer rebates for water efficient fixtures and appliances. Communities with older housing stock should consider the costs/benefits of implementing a wide-ranging program to replace older, high-water-use toilets through retrofit/rebate programs as described above. The state should investigate opportunities to offer rebates on water efficient appliances through the energy industry.
   - **Recommend installation of water efficient appliances.** Water suppliers should work with appropriate local boards and in cooperation with the water superintendent to strongly recommend installation of water efficient household appliances, including clothes washers and dishwashers, in new developments and redevelopments whenever feasible.
   - **Incorporate water conservation into MEPA review for large new developments.** EOEA should work with MEPA to develop a standard set of water conservation recommendations as part of the MEPA review for large new developments and redevelopments. The recommendations should include but not be limited to the installation of water efficient household appliances and meeting all appropriate standards and recommendations for lawn and landscape water conservation as included in Section 9- Lawn and Landscape.
   - **Promote the use of "instant on" tankless water heaters.** Also referred to as "point of use" tankless water heaters, these systems save water, as less water goes down the drain waiting for the hot water to reach your sink or shower, and provide significant energy savings over conventional tank water heaters.
2. **Provide Residential Water Audits.** Communities should consider providing free or low cost residential water audits to customers, targeting the largest users first. A residential water audit should include the following components at a minimum:
   - Inspection of toilets, showers, faucets, clothes washers, dishwashers, water filters, water softeners, evaporative coolers, spa/Jacuzzi, and "other" for leaks, flow rate, presence of water saving retrofit devices, and efficient use of fixtures and appliances by residents. A sample worksheet for residential water audits is included in the Handbook of Water Use and Conservation (Vickers, 2001)

3. **Promote Efficient Non-landscape Outdoor Water Use.** The State, communities and other applicable public/private/nonprofit organizations should promote efficient outdoor residential water use by educating consumers and providing them with incentives to conserve. Other efforts should include education to encourage the following:
   - Covering swimming pools when not in use to prevent evaporative losses.
   - Sweeping driveways, walks and decks with a broom rather than hosing them off.
   - Washing vehicles using a bucket and sponge, employing a hose for rinse only.
4. **Promote Efficient Lawn and Landscape Water Use.** See Section 9.0 for lawn and landscape recommendations.
5. **Promote Waterless Plumbing Fixtures.** Communities, developers and individuals wishing to go beyond current standards to do more to conserve water should consider installing waterless plumbing fixtures such as a composting toilet or 3-ounce foam flush toilet, which can be flushed with only 6 ounces of a soapy solution (3 ounce pre-flush and 3-ounce post flush). State and municipal buildings should be used as demonstration sites for these technologies.
6. **Minimize/discourage use of garbage disposals**. Encourage consumers to reduce the use of sink garbage disposals to improve septic system function (where applicable) and save water. Divert compostable waste to a compost pile instead. Finished compost then can be added to the soil around the home or even spread thinly on the lawn to help boost its soil moisture retention capacity and reduce the need for watering.
7. **Educate homeowners about how water conservation benefits water quality**. Water conservation helps septic systems work better and last longer, and in sewered communities reduces the burden on wastewater treatment facilities.

6.0 Public Sector

Municipal and state buildings and facilities should be at the forefront on indoor and outdoor water use efficiency. They should set an example and lead the way in water conservation, water saving techniques and concepts. These sites should serve as demonstration sites with signage to make the public aware that the state and municipalities are leaders in water conservation. The following standards and recommendations will help emphasize and implement water conservation and efficiency in government buildings and facilities. They will also help to accurately account for water use and serve as demonstrations of water saving techniques and concepts to the public.

Standards

1. Municipal and state buildings
   - Conduct indoor and outdoor audits and account for full use of water, based on full metering of public buildings, parks, and other facilities.
   - Analyze existing data to spot trends, patterns, and unexplained increases that could indicate leaks or inefficient use of water.
   - Identify measures where the greatest efficiencies and potential savings can be realized.
   - Focus on replacing/retrofitting water consuming equipment in buildings (e.g. bathrooms, boilers, chillers).
   - Practice good, efficient lawn and landscape water use techniques as described in Section 9.0.
2. Meter or estimate contractor use of water from fire hydrants for pipe flushing and construction.
3. Strictly apply plumbing codes and incorporate other conservation measures in new and renovated buildings.

Recommendations

1. Public buildings should be built or retrofitted with equipment that reduces water use, such as faucet aerators, low flow showerheads, composting or low flow toilets (such as the new "dual flush" models), and self-closing faucets. Water saving devices and measures should be well identified to users of public buildings and facilities.
2. Adopt outdoor water use strategies as per recommendations in section 9.0 on lawn and landscape.
3. Public buildings should be used as demonstration sites for innovative water conservation techniques such as composting, foam flush and dual flush toilets, cisterns for rain collection, and water-wise landscaping.

7.0 Industrial, Commercial and Institutional (ICI)

Water is crucial for the functioning of industrial, commercial, and institutional facilities (such as hospitals, schools, prisons, universities, colleges, etc.). It may be used for heating, cooling, and processing, and includes an appreciable sanitary and landscaping component. In many communities these facilities constitute the largest water users and instituting water conservation measures will help reduce the overall community water use significantly. It can also result in appreciable monetary savings for the facility. Conservation measures must be tailored to reflect the type of water use and characteristics of individual facilities (see Appendix F for BMPs). They can be built into an industry's strategy to comply with sewer and National Pollutant Discharge Elimination System (NPDES) discharge requirements. The following standards and recommendations aim to increase the efficiency of water use through the use of best available water saving technologies.

Standards

Compliance with the standards requires that

1. All industrial, commercial, and institutional water users carry out a water audit to determine the location and amount of water used for heating, cooling, processing, sanitary use, and outdoor use (see Appendix H for sample ICI water audit). Findings from the audit should be the basis for actions to conserve water such as,
   - Recycling cooling waters to achieve greatest water use efficiency/closed loop cooling.
   - Reuse of cooling waters as raw material in processing.
   - Use of non-potable water (in conformance with plumbing code and MassDEP regulations to assure safe drinking water and to avoid cross connections).
   - Use of heat-sensitive valves to control cooling equipment.
   - Replacing water cooling with air cooling (where possible within air quality standards).
   - Installation or retrofit of sanitary water devices, meter maintenance and calibration, and xeriscaping.
2. Significant users (i.e. those using greater than 50,000 gpd) install separate meters for process water so that water can be accounted for and appreciated as a raw material in production, and for sanitary use.
3. All industrial, commercial, and institutional water users develop and implement a water savings strategy, addressing among other items: demand management, leak detection and repair, a program of preventive maintenance, and a program of employee education.
4. In new and renovated buildings, comply with plumbing codes, use the best available technologies for water conservation, and reuse treated wastewater within the facility to the extend possible.
5. Practice good lawn and landscape water use techniques as described in Section 9.0.

Recommendations

1. The EOEA Office of Technical Assistance should be reinforced in its efforts to provide technical assistance to companies and large water users and work with industry groups and suppliers. Water using industries should be educated about the availability of OTA as a resource.
2. Significant users should aim to, wherever possible, decrease their average water use by at least 10%.
3. All industrial, commercial, and institutional users should install/retrofit water saving sanitary devices, including but not limited to low-flow showerheads, faucet aerators, toilet displacement devices, and/or low flow or dual flush toilets.
4. Industrial and commercial users should work with code officials, standards committees, state programs, manufacturers, and legislators to promote water conservation and efficient use.
5. Commercial and industrial facilities often include large areas of impervious surfaces (building rooftops, parking lots, etc.) which offer excellent opportunities for rainwater harvesting that can serve as a supplemental water supply source, and/or infiltrating clean runoff into the ground where it can replenish aquifers and streamflow.
6. See Section 9.0 for lawn and landscape recommendations.

8.0 Agricultural

Commercial agriculture is highly water dependent and economically sensitive to water availability and quality. Agriculture cannot exist without access to water. In Massachusetts, agricultural water users tend to be self-suppliers with wide ranging needs for water. Water is used for irrigation of crops and nursery stock, harvesting of crops (cranberries), as the medium for aquaculture, for washing and processing of commodities, as a drinking source for livestock, and for cleaning and cooling animals.

Agricultural needs for water vary by type of enterprise and on a seasonal basis. Water demands are also site specific and, depending on the type of enterprise, are affected by multiple factors including: climate and weather; number and types of animals; soil water holding capacity and infiltration rate; and differing crop needs.

The basis for any conservation approach to water use in agriculture is the process of managing the volume and frequency of water use in a planned and efficient manner. However, any conservation approach to agriculture should strike an appropriate balance between both agricultural needs for water and the need to conserve water. Examples of conservation approaches in agriculture include proper irrigation scheduling, in both timing (daily and seasonally) and volume; control of runoff; the uniform application of water; irrigation technologies, such as drip irrigation (where appropriate); "pop-up" sprinkler heads (for cranberry growers); and the use of tail-water recovery systems.

The standards encourage the adoption by farmers of a conservation approach to water use that is appropriate for their operation and site conditions.

Standards

1. A water conservation approach where water is used in a planned and efficient manner with appropriate amounts and frequency to meet needs, and with no excessive water loss, should be part of the management of an agricultural operation.

Recommendations

1. A Water Conservation Working Group comprised of agricultural stakeholders should be coordinated and facilitated by the Department of Agricultural Resources (DAR). The role of the working group is to identify ways to improve water efficiency in all categories of agricultural water use and facilitate water use planning and drought contingency planning by growers.
2. Industry member associations and commodity groups should be encouraged to develop and promote industry specific best management practices which are dynamic, adaptable to new technology, and are selected based upon both economic and environmental concerns.
3. The Agro-Environmental Technology Grant[8] program should be funded and should include funding dedicated to the development of innovative technologies for water conservation.
4. Micro-irrigations systems, such as subsurface drip irrigation (SDI) should be adopted where suitable. According to NRCS, micro-irrigation systems are suited to orchard and row crops, windbreaks, greenhouse crops, residential and commercial landscape systems, on steep slopes where other methods would cause excessive erosion or on areas where application devices interfere with cultural operations.

[8] Other DAR Grants:
1. Agricultural Environmental Enhancement Program, 251 Causeway Street, Boston, MA 02114. Contact: 617-626-1700
2. Environmental Quality Incentives Program, USDA Natural Resources Conservation Service, 451 West Street, Amherst, MA 01002. Contact: 413-253-4350

5. Growers should maintain adequate soil moisture for optimum plant growth without causing excessive water loss, erosion or reduced water quality.
6. Where sprinkler systems are used for irrigation, the systems should be capable of uniform application of water with minimal evaporative loss and minimal surface run-off. The amount of water applied should only be sufficient to fill the effective crop root zone
7. Irrigation system efficiency should be evaluated on a regular basis.

9.0 Lawn and Landscape

The WRC formally added the Lawn and Landscape Water Conservation Standards and Guide as an addendum to the previous version of the Water Conservation Standards in October 2002. At that time, the Commission also adopted the following policy on outdoor water use:

> *Water used for maintaining landscapes and lawns should not be used at the expense of public health and safety of the environment. Water that is used for maintaining landscapes and lawns should be used in a manner that minimizes such use through the implementation of sound water conservation and water efficiency practices*

The policy statement, standards and recommendations are incorporated and defined herein with revisions to bring them up to date.

Standards

1. Develop and implement seasonal demand management plans as part of the drought management plan. These plans must identify water supply and environmental indicators (such as streamflow triggers) to serve as water use restriction triggers and outline a set of increasingly stringent water use restrictions that are designed to protect public health and the environment.
2. Each community must adopt and implement (as appropriate) a water use restriction bylaw, ordinance or regulation, which could apply to private wells, as appropriate. This bylaw, ordinance or regulation should provide the community government or designee (i.e. water supplier, police department, etc.) with the ability to implement mandatory water use restrictions. These restrictions should be tied to environmental and/or water supply indicators as outlined in a seasonal demand management plan. See Appendix B for model water use restriction bylaws.
3. Abide by water restrictions and other conservation measures implemented by your municipality or water supplier.

Recommendations

The Guide to Lawn and Landscape Water Conservation contains detailed recommendations and suggestions for a wide range of potential users. While the recommendations are briefly summarized here, please refer to the Guide for more detailed discussion of each recommendation. Also, see Appendix D, table 3 for a summary of water conservation recommendations for lawns and landscapes.

Unless otherwise noted, these recommendations apply to 1) owners and managers of residential, industrial, commercial and institutional lawns and landscapes; 2) recreational fields and golf courses; 3) owners and managers using private wells or water sources; 4) municipalities and other public water suppliers; and 5) state agencies.

1. **Maximize efficiency**. Maximize efficient outdoor water use to meet a goal of outdoor water use comprising only a small portion of total water use, with a long-term goal of continuing to reduce this number.
2. **Minimize watering**. Water only when necessary (in most years Massachusetts generally has enough rainfall to naturally supply the water needs of most healthy, mature lawns *without the need for watering*). Clients and other users of lawns, recreational fields, etc. should be informed that turf grasses naturally go brown and dormant during hot dry weather and will revive when cooler wetter weather returns.
3. **Maximize efficiency of automatic irrigation systems**. Install water conservation equipment and properly maintain automatic irrigation systems. Use the best available technology to ensure maximum water efficiency and conduct regular irrigation audits to evaluate and adjust water efficiency. Basic and recommended features of a good irrigation system controller are outlined in Table 3 and associated references, Appendix D
4. **Reuse and/or infiltrate rainwater**. Collect and reuse rainwater for landscaping needs, or infiltrate roof runoff (e.g., redirect gutter downspouts away from pavement and into places where it can infiltrate into the ground, like a rain garden, or be stored in a rainwater harvesting system).
5. **Practice Water-wise, Natural Landscaping**. The fundamentals of water-wise landscaping are summarized in Table 3 and associated references, Appendix D.

6. **Do not water**. Do not water lawns and do not install automatic lawn irrigation systems in water short communities. In all communities, strive to minimize use of potable public water supply to water lawns.
7. **Enhance Soil Health**. Ensure adequate depth and type of soil (at least 6 inches of good topsoil). The texture, organic content, pH level, drainage, salinity and fertility are important characteristics of soil that should be considered before planting anything. Some tips for soil improvement include using sand to increase drainage, using peat moss, manure or compost to improve moisture retention, and using fertilizer carefully for strong root growth[9]. Mulching also helps to retain soil moisture and reduce the need for watering.
8. **Water efficiently**. Avoid watering during precipitation events and during the hottest part of the day (9 am to 6 pm).
9. **Mow high**. Mow lawns at the highest recommended height (at least 2.5 inches).
10. Plant **drought tolerant species**, native species whenever possible.

Additional Recommendations:

Owners and Managers of Recreational Fields and Golf Courses

- Design and maintain facilities to minimize water use, ideally relying on rainwater to meet all irrigation needs.
- If studies indicate that irrigation is required to maintain proper turf health and playability, follow best management practices outlined above and in Table 3 and associated references, Appendix D to minimize water use.

Owners and Managers using Private Wells or Water Sources

- Abide by local water restrictions, especially if the private well is in the zone of contribution of the public water supply.
- Unless properly permitted, do not withdraw water directly from any ponds, lakes, streams or rivers, except for any ponds constructed specifically for irrigation purposes.

Municipalities and other Public Water Suppliers

- Raise public awareness through an education and outreach program on outdoor water use and/or demonstrations of water-wise landscaping on municipal properties.
- Consider developing a water conservation bylaw that includes some or all of the following provisions:
  - requires water conservation equipment and audits for automatic irrigation systems;
  - minimizes installation of high water use landscape areas; and
  - restricts land clearing and lawn size in new developments and require a minimum 6 inch depth of topsoil on all cleared areas to help retain moisture and reduce the need for watering.
- Provide landscape water audits for residential, industrial, commercial and public properties that are large water users.
- Provide rebates for the installation of ET Controllers and/or moisture sensors for automatic irrigation systems.
- **Control direct water withdrawal from water bodies.** Communities should consider adopting an ordinance that prohibits the taking of water from any surface water source without advance written permission from the Conservation Commission and paying the same (or more) for the water than it would have cost the proponent to obtain it directly from the public water supplier. Passing such a bylaw would help control the documented problem of hydro-seeding or other water tanker trucks sticking their hoses directly into local waterways and taking water without permission or paying for it, and sometimes contaminating the body of water from which they withdrew the water. Note: The water used for agricultural operations (as defined in MGL c128 section 1A) is necessary for these commercial activities to continue. Therefore, the conditions of this section should not cover water used by agricultural operations.

[9] The following websites describe the importance of amending soils with organic matter for improving the soil's water retention characteristics for reducing summer water consumption.
Sustainable Building Sourcebook http://www.greenbuilder.com/sourcebook/XeriscapeGuideline2.html
American Horticultural Society http://www.ahs.org/040329_TAG/M_J12.pdf
http://www.ahs.org/publications/the_american_gardener/0005/smartgarden.htm

State Agencies

State agencies with property should use their property to demonstrate the ability to develop and manage low-water use landscapes. Appropriate public education and outreach should publicize these efforts. In addition, state property managers should practice the following:

- Implement water-wise landscaping and use of native vegetation to reduce outdoor watering, emphasize the advantages of drip irrigation over broadcast watering, and promote these measures in educational campaigns.
- Where feasible, use non-potable water supplies for landscaping, street cleaning and building washing, within public health considerations, existing cross connection programs, and plumbing board decisions. State and municipal facilities often include large areas of impervious surfaces (building rooftops, parking lots, etc.) which offer excellent opportunities for rainwater harvesting that can serve as a supplemental water supply source, and/or infiltrating clean runoff into the ground where it can replenish aquifers and streamflow.

State Regulatory Programs

- The MassDEP is responsible for issuing permits under the WMA for those withdrawing more than 100,000 gallons per day from new sources, or those increasing withdrawal from existing sources. The MassDEP should continue to condition the permits of sources to attempt to avoid significant environmental impacts. MassDEP should also work to assist water suppliers in developing drought/demand management plans and in providing technical assistance to those adopting and implementing water use restrictions as appropriate.
- The State, in conjunction with potentially regulated communities and other interested parties, should evaluate the benefits of establishing a licensing program for irrigation professionals which incorporates an ecological component that covers potential environmental impacts to aquatic ecosystems that can result (directly or indirectly) from irrigation if conducted in an environmentally-responsible manner.

State Procurement Activities

- State agencies responsible for the renovation and maintenance of state facilities, and state agencies that procure services for lawn and landscape maintenance should ensure that the appropriate lawn and landscape design, and maintenance and construction guidelines for minimizing outdoor water use are included in the procurement bid documents and in the bid evaluation criteria.

10.0 Public Education and Outreach

Water conservation is a key component of the effort to ensure the sustainability of a community's water resources to meet the needs of human and natural communities now and in the future. The responsibility for ensuring a sustainable water future lies with the community as a whole; everyone has a role to play to make sure that all water (rain water, stormwater, public water supply, etc.) is treated responsibly and planned for properly.

Education to both the public at large, municipal officials and to the water suppliers is crucial to generating understanding of the issues, and implementing, and creating acceptance of water conservation activities. It is important to provide to the public the basic understanding of sound water resources management and planning, and explain the associated economic and environmental benefits.

Four main areas of emphasis for an educational program are:

- Highlighting the environmental benefits of keeping water local, and reducing water demands, including the relationship of ground water to surface water and the potential impacts of withdrawals on streamflow and instream uses such as habitats for fisheries and other wildlife and water-based recreation, and pollution dilution; the relationship between pumping and salt water intrusion for coastal areas.
- Explaining that water conservation helps water quality as well. It helps septic systems work better and last longer and helps wastewater treatment plants function better. Water conservation also enables more water to be retained in the natural environment where it helps dilute pathogen and other pollutant concentrations and buffers waterways from excessive heating or freezing that can harm aquatic life.
- Showing that investments in efficiency and conservation will provide water users with long term savings compared to the cost of developing and treating new water supply sources and wastewater treatment facilities. For example, through a domestic device retrofit program, including follow-up visits or mailings, water suppliers can make customers aware that making a few simple changes can provide tangible savings.
- Explaining to water users all the costs involved in providing water, including planning, engineering, construction, operation, maintenance, treatment, wastewater facilities costs, piping, leak detection, compliance costs, salaries, protection costs, pensions, health care, staff training, public education, etc.

Standards

Compliance with the standards requires that

1. Each community develop and implement an education plan, which includes most, if not all items in the following list. The education plan should especially reach schools with media that appeals to children, including getting them involved in water resource projects and field trips. Water users and agencies should choose from these and other resources to create and implement programs best suited for their particular situation.
    - Target the largest users early on to realize the greatest potential savings and to demonstrate the benefits of a conservation program.
    - Include in bill stuffers and/or bills a work sheet on the reverse to enable customers to track water use and conservation efforts and estimate the dollar savings.
    - Public space advertising/media stories on successes (and failures).
    - Conservation information centers perhaps run jointly with electric or gas company.
    - Speakers for community organizations.
    - Public service announcements; radio/T.V./audio-visual presentations on supply sources and current status.
    - Joint advertising with hardware stores to promote conservation devices.
    - Use of civic and professional organization resources.
    - Special events such as Conservation Fairs.
    - Multilingual materials made available as needed.
    - Contests and recognition for innovation incorporated into the public education program.
    - Water conservation workshops for the general public and included in the school curriculum.
    - Information on water-wise landscaping, gardening, and lawn care practices.
    - Retrofit and rebate programs include educational information.
    - Public Education programs

2. Public education programs should address the issue of why it is equally important for self-supplied water users (e.g., home or businesses on their own private wells) to conserve water, especially when their water source might dry up an aquatic habitat or deplete the water available for public use (e.g., their withdrawal point shares the same aquifer with the public wellfield).

Recommendations

1. Communities should hire a part- or full-time water conservation coordinator or circuit rider shared among several water systems. A draft job description for a water conservation coordinator is included in Appendix G.
2. To facilitate implementation of these standards a position of State Water Conservation Coordinator should be established in the Executive Office of Environmental Affairs to work with water suppliers, industries, watershed associations, and other local entities as well as with existing state programs.
3. Water suppliers and the state should consider using social marketing to help build public support for water conservation. Social marketing is a valuable technique that can help persuade people to use water and land in an environmentally-responsible manner.[10]
4. Other town boards should get involved in water conservation, especially those regulating land use (planning and zoning boards), managing Town property (park and recreation departments, cemetery departments) looking after water resources and aquatic habitats (conservation commissions, boards of health) and open space/Community Preservation committees. These entities can help promote water conservation as well as restore the hydrological balance by enhancing infiltration of clean water into the ground thus replenishing aquifers and streamflow.

[10] Fostering Sustainable Behavior through Community-Based Social Marketing
http://www.cbsm.com
Most people know that to protect the environment they should recycle more, water their lawn less, get out of the car and take a multitude of other steps to reduce their ecological footprint. But as often as not the actions people take are not consistent with what they know to be true about the state of the environment. In fact, research demonstrates that simply providing information usually has little or no effect on what people do. But if not brochures, then what? Over the last several years a new approach, community-based social marketing (CBSM), has emerged as an attractive alternative for delivering programs to change environmental behavior. CBSM uses many of the same tools and techniques businesses and advertisers employ to market their services and products to consumers to, instead, persuade people to adopt more socially- and environmentally-responsible behavior such as composting, waste and litter reduction and water conservation. Assembled and maintained by New Brunswick-based social marketing guru Doug McKenzie-Mohr, the cbsm.com website consists of six resources: an online guide which provides valuable information on the use of CBSM to design and evaluate programs to foster sustainable behavior; searchable databases of articles, cases, graphics, and downloadable reports on fostering sustainable behavior, and discussion forums for sharing information and asking questions of others. For more info, contact Doug at dmm@cbsm.com or (506) 455-5061.

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APPENDIX A: WATER BANK GUIDANCE

Introduction

Demand management facilitates the generation of physical savings of water as well as economic savings (Rosegrant, 1997) – i.e. it brings about conservation in order to help sustain current and future supplies and induces an effective cost recovery system (National Research Council, 1995). Economic instruments that can be used could be tradable water permits, water pricing, or water banking. These instruments are based on the premise that a value can be associated with each water use activity and it is this differential that makes transfers or purchases possible and attractive. This value also helps make effective management and allocative decisions.

Over the years, a "water bank" has come to mean different things to different people. In the western states, water banks are typically systems of valuing, trading, buying or selling water rights. Permanent water banks have been established in Idaho and Texas. The state of California, in 1991, 1992 and 1994, set up emergency drought water banks to reallocate water. Water was purchased from those farmers who were willing to leave their lands idle or were willing to use groundwater instead of surface water. This was then sold to either cities or farms or used for instream uses or to dilute pollutants (Frederick, 1998).

The Benefits of a Water Bank

Water banking can be an effective management tool for "water short" communities where development pressure is exceeding the carrying capacity of water resources. It is also a good option for communities concerned about their ability to meet projected water demand and to protect the environment. A water-banking program can play an important role in freeing up water and ensuring that there is an adequate supply of water for competing uses – i.e., instream flow and habitat, recreation, wetlands, water supply, and economic development. It can mitigate, or offset, the impacts of water withdrawals, balance the water budget, assist in restoring and protecting instream flow, promote water conservation, and ensure an adequate supply of potable water. Massachusetts' communities are beginning to use this tool to accommodate future growth while ensuring the sustainability of their water resources. One example is Weymouth's water bank program which saved 1.2 million gallons a day in 2003 (see description below).

What is a 'Water Bank'?

In Massachusetts, the term water bank is evolving to mean a system of accounting and paying for measures that offset or mitigate water losses due to water withdrawals, sewering, and/or increased impervious areas that prevent aquifer recharge[11]. The primary goals of a water bank are to balance the water budget, reduce water losses, increase water efficiency, and keep water local. [12]

There is no "one size fits all" approach to water banking and municipalities should have the flexibility to adopt a program that best fits their particular circumstances. There are, however, some key organizing principles that communities should follow when developing an effective water-banking program.

[11] Kerry Mackin, Ipswich River Watershed Association.

[12] Interbasin transfers, for example, are not subject to inclusion in a water bank as they by definition do not keep water local. However, reductions in the amount of water transferred out-of-basin, via sewers for example, would qualify as mitigation under a water bank.

They are:
1. A dedicated fund, or banking mechanism is necessary
2. At least a 2:1 ratio for mitigation should be the goal in medium and high stressed basins
3. If fee-based, the fee charge must bear a reasonable relation to the cost of implementing the offset and the program's administrative costs, and
4. If the work is performed by the developer, documentation must be provided, and there must be verification by the local department or board administering the program

Because a 1:1 ratio only preserves the status quo in already degraded watersheds, and because measuring the gains from individual water offset measures is often imprecise, to protect or restore water resources especially in medium or high stressed basins, a ratio of at least 2:1 is recommended. In other words, for every gallon of new water demand projected for development, redevelopment or expansion projects, the goal should be saving or retaining at least two gallons in the basin where the water is being withdrawn.

While water conservation measures - i.e., retrofits of public buildings and older residences with low flow toilets, showerheads and faucet aerators, have been the primary currency of Massachusetts water banking programs to date, there are a variety of techniques that can be used to offset water supply impacts. There are "a wide variety of activities that can return water or prevent water loss in the basin, such as reduced infiltration and inflow, recharge of stormwater, and retrofit of existing development using low impact development principles". The additional capacity can also be gained through groundwater recharge of treated wastewater locally and reuse of grey water. There are also a host of water conservation measures
- subsidizing low water use washing machines and dishwashers, xeriscaping and installation of rainwater collection systems for lawn irrigation that can be utilized in a water-banking program.

A water bank can be structured like inflow and infiltration (I/I) mitigation that many communities are now requiring for new and redevelopment projects. Ratios ranging from 4:1 to 10:1 are being used. This can help to create capacity, or to fulfill regulatory requirements for regional wastewater systems. The work can be performed either by the developer, or a fee can be charged and the I/I removed by the municipality's DPW or sewer department.

If a municipality opts to charge a per gallon fee, either to perform the work itself, or to contract it out, the fees should be deposited in a dedicated enterprise fund and used solely to accomplish the offset measures, and to fund the program's administrative expenses. If the banking program allows the entity seeking the increase in water to perform the offset or achieve the requisite savings, adequate documentation is critical to the success of a water-banking program. The documentation and review and verification of this by the municipal department or the public water supplier administering the program is a validation that the work has been performed. Regardless of which entity performs the measures, it is important that an accounting system be developed for tracking and reporting on the measures to ensure that the savings are in fact being achieved.

A water bank can also be structured to include market mechanisms in which those seeking new or increased water use could buy credits previously banked in excess of the 2:1 ratio in lieu of performing the work themselves. A water bank could also involve multiple towns or be organized on a regional or watershed basis.

Case Study

Town of Weymouth's Water Banking Program

The Town of Weymouth developed a successful water banking program that has enabled it to stay within its authorized withdrawal volume. The bank has helped the town to accommodate new growth and water demand, and to implement an aggressive water conservation program.

Weymouth's Water Use Permit Program, administered by its DPW applies to new customers and existing ones seeking to increase water use, for example through the addition of a bedroom or a commercial process. It requires that for every gallon of new demand, two gallons of water, i.e. a 2:1 water savings be achieved. Projected water use is based on Title 5 flows.

The DPW developed guidelines on water saved by various low-flow household devices and a list of older businesses and residences suitable for installation, or retrofitting. Originally, permit applicants were responsible for doing the residential retrofits, or in the case of businesses, modifying water use practices and processes to create the required savings; however, in 2000, the program was expanded to give applicants the option of paying a $10.00 per gallon mitigation fee in lieu of performing the actual work.

The mitigation fee, based on a contractor's cost per gallon to perform the work, plus administration costs, is held in a dedicated enterprise Water Conservation Fund, which the Water Department uses to achieve the requisite mitigation. Water savings in excess of 2:1 savings are "deposited" in the water bank for the Town's use.

While affordable housing developments under M.G.L. c. 40B are subject to the fee, there is a hardship exemption available for individual homeowners. The Fund has also been used to install rain sensors on automatic irrigation systems. The program has not had a negative impact on development, which remains robust in Weymouth.

APPENDIX B: MODEL BYLAWS

For each bylaw, the final draft will specify legal standing and context

- Private Wells (Falmouth)
  - Falmouth, Article 17, section 223-4 pertains to the board of selectman's authority to declare a state of water supply conservation and provides in pertinent part as follows: *However, if the Board of Selectmen makes a specific finding that the shortage of water exists because of a clear and imminent threat to the sole source aquifer underlying Falmouth, such threats to include severe drought, environmental pollution or salt water intrusion, the restrictions adopted pursuant to Section 223-5 shall apply to all citizens, water users, and consumers regardless of the source of water supply.*

- MassDEP Water Use Restriction Model Bylaw http://www.mass.gov/dep/brp/dws/files/wmabylaw.pdf
- Cape Cod Commission Model Land Clearing, Grading and Protection of Specimen Trees Bylaw http://www.vsa.cape.com/~cccom/bylaws/clearing.html
- Bylaw to establish a fine for unauthorized use of a fire hydrant (East Bridgewater)
  - Article 25, Part Three- Offenses and Penalties of the Town By-Laws
    XX. Unauthorized Use of Fire Hydrant
    i. Any person, other than an employee of the town performing municipal services, taking or using water from a Town fire hydrant without the prior written consent of the Board of Water Commissioners shall pay to the town a fine in the amount of three hundred dollars ($300.00) for each such offense. The fine may be enforced criminally or non-criminally in the manner set forth in Article XVI.
    ii. Any person taking or using municipal water from a Town fire hydrant shall be liable for any damage caused by such action including, but not limited to, damage to any fire hydrant, water main or connection.
- Water-wise/Water efficient/Native landscaping bylaws from other states:
  - Arizona
    http://www.ci.gilbert.az.us/ordinances/waterconservation.cfm
  - California
    http://www.co.marin.ca.us/depts/CD/Forms/00000067.pdf
  - Colorado
    http://www.dola.state.co.us/smartgrowth/documents/Water%20Efficient%20Landscaping%20Design.pdf
  - Florida
    http://sarasota.extension.ufl.edu/Hort/LandscapeOrd.html
  - Nevada
    http://www.snwa.com/html/cons_index.html

APPENDIX C: EDUCATION AND OUTREACH MATERIALS

- Water Bill Inserts

Are you a heavy water user?

To find out how your water use compares to the suggested maximum of 65 gallons per person per day, see the handy lookup chart opposite.

If you use over 100,000 gallons per year, you should get a free water audit from Energy New England, courtesy of the Sharon Water Department. They will provide you with a customized analysis that will highlight the most cost-effective strategies for conserving water in your home.

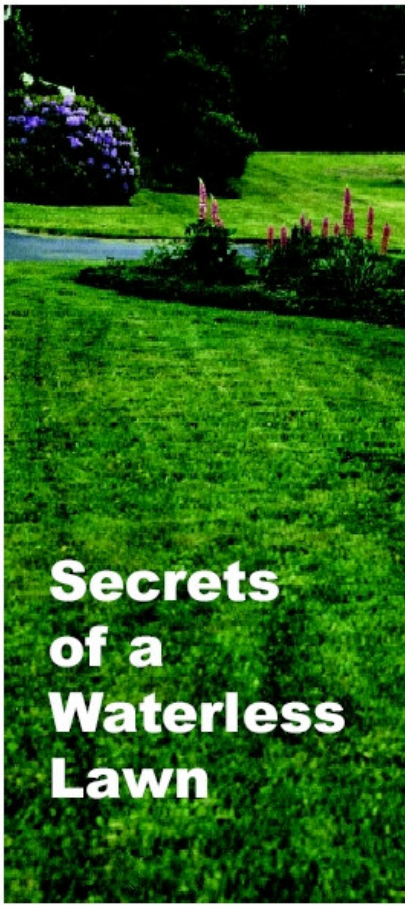
Please do your part to help our community use water efficiently.

Sharon has a long and proud history of protecting and preserving our drinking water aquifers as well as the natural beauty of our town. Read about the sensible lawn care practices, and efficient toilets and clothes washers described in this pamphlet. Let's use our municipal well water efficiently. It will save money, improve our local ecosystem, and maintain our water independence.

Is your water use under 65 GPCD?

Gallons Per Capita Daily (GPCD)

Gallons used in 6 months (for annual gpcd, average your last 2 water bills)	NO. OF HOUSEHOLD OCCUPANTS							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
4,000	22	11	7	5	4	4	3	3
6,000	33	16	11	8	7	5	5	4
8,000	44	22	15	11	9	7	6	5
10,000	55	27	18	14	11	9	8	7
12,000	66	33	22	16	13	11	9	8
14,000	77	38	26	19	15	13	11	10
16,000	88	44	29	22	18	15	13	11
18,000	99	49	33	25	20	16	14	12
20,000	110	55	37	27	22	18	16	14
22,000	121	60	40	30	24	20	17	15
24,000	132	66	44	33	26	22	18	16
26,000	142	71	47	36	28	24	20	18
28,000	153	77	51	38	31	26	22	19
30,000	164	82	55	41	33	27	23	21
32,000	175	88	58	44	35	29	25	22
34,000	186	93	62	47	37	31	27	23
36,000	197	99	66	49	39	33	28	25
38,000	208	104	69	52	42	35	30	26
40,000	219	110	73	55	44	37	31	27
42,000	230	115	77	58	46	38	33	29
44,000	241	121	80	60	48	40	34	30
46,000	252	126	84	63	50	42	36	32
48,000	263	132	88	66	53	44	38	33
50,000	274	137	91	68	55	46	39	34
52,000	285	142	95	71	57	47	41	36
54,000	296	148	99	74	59	49	42	37
56,000	307	153	102	77	61	51	44	38
58,000	318	159	106	79	64	53	45	40
60,000	329	164	110	82	66	55	47	41
62,000	340	170	113	85	68	57	49	42
64,000	351	175	117	88	70	58	50	44
66,000	362	181	121	90	72	60	52	45
68,000	373	186	124	93	75	62	53	47
70,000	384	192	128	96	77	64	55	48
72,000	395	197	132	99	79	66	56	49
75,000	411	205	137	103	82	68	59	51
80,000	438	219	146	110	88	73	63	55
85,000	466	233	155	116	93	78	67	58
90,000	493	247	164	123	99	82	70	62
95,000	521	260	174	130	104	87	74	65
100,000	548	274	183	137	110	91	78	68



Reduce costly lawn irrigation and still have a nice lawn

Summertime demand for water surges almost 50% over indoor use in winter, depleting our groundwater when it is needed most to sustain ecosystems in local rivers, lakes and streams. Lawn watering is the main reason for this surge in water use.

Overwatering is expensive, and can even cause harmful fungus outbreaks. One inch of water per week is enough to keep a lawn green. That includes natural rain, which averages over 3" per month in summer.

If you can tolerate a period of dormancy in late summer, you can have a healthy, beautiful lawn without any irrigation at all. The quality and thickness of the topsoil is key. A layer of rich, organic loam 6" to 8" thick retains moisture, encourages deep roots, and harbors earthworms that aerate and enrich the soil with their castings.

Topsoil can be supplemented by leaving grass clippings and leaves shredded by your mower to decompose on your lawn. This builds a rich organic layer that holds moisture and recycles the costly nutrients you paid for when you fertilized your lawn. It also makes lawn mowing easier! To build topsoil faster, apply a thin layer of rich loam or compost once or twice a year.

Applying weak organic fertilizer in spring and fall aids moisture retention and adds micronutrients. Mix it with equal parts of 10-10-10 for root development, and lime to counteract acid rain. Using white powdered lime helps you see where you have already fertilized. Apply this mix at a rate of about 20 lbs. per 1,000 sq. ft.

More tips for a healthy lawn:

• Cut it long. Set your mower to its highest setting. Taller grass provides shade to slow evaporation from the soil.

• Mow it regularly. You should be removing less than 1/3 of the grass when you mow.

• Sharpen your mower blade. A dull blade shreds grass instead of slicing it.

• Tolerate clover in your lawn. Clover is a legume and adds nitrogen to the soil.

• Avoid pesticides. They kill beneficial earthworms. If grubs become a problem, apply milky spore. Once established in the soil, milky spore can protect against grubs for years!

• Overseed with drought-hardy perennial grass seed in early September to crowd out weeds. Apply compost, dehydrated manure or peat moss to newly seeded areas, especially bare spots, to hold moisture and help establish new grass.

• Compost your own "black gold" for use on the lawn and in your garden. Add leaves, weeds, melon rinds, carrot peels, tea bags, apple cores, banana peels, and other vegetable wastes. Crushed egg shells are good too. Avoid meat and high-fat items like peanut butter that smell and attract pests.

• For additional information, visit: www.nsrwa.org/greenscapes/guidebook/

Tips and rebates for saving water indoors:

• Get a $100 rebate for High Efficiency Toilets (HET's) that average under 1.28 gallons per flush (gpf). A HET saves about 8,000 gallons per year compared to an older 3.5 gpf model. Be sure the dual-flush or pressure assist model you choose is MaP rated to flush at least 500 grams. See: www.cuwcc.org/Uploads/product/HET.pdf

• Install a front-load clothes washer using under 15 gallons per load (gpl) to replace your top-load washing machine that may use 35 gpl or more. The Water Dept. offers a $200 rebate for models of over 3 cu. ft. capacity that use less than 15 gpl ($150 for smaller models that use less than 12 gpl). Front-load clothes washers also save energy, reduce drying time, use less detergent, and cause less fabric wear.

Before you buy, call your local Water Department.

• Check for leaks. Put food coloring in your toilet tank for 15 minutes. If you see color in the bowl, it's leaking. Also, if your water meter advances while no one is home, there's a leak.

OUR REBATE PROGRAM

Get a $100 credit on your water bill for installing a high-efficiency toilet!

Get a $200 credit on your water bill for installing a front load washing machine!

These advanced devices deliver many benefits. They reduce your water bill and may extend the life of your septic system.

Gallons Per Capita Daily (GPCD) Lookup Table*

GALLONS USED IN 6 MONTHS (for annual GPCD, average your last two water bills)	NO. OF HOUSEHOLD OCCUPANTS							
	1	2	3	4	5	6	7	8
4,000	22	11	7	5	4	4	3	3
6,000	33	16	11	8	7	5	5	4
8,000	44	22	15	11	9	7	6	5
10,000	55	27	18	14	11	9	8	7
12,000	66	33	22	16	13	11	9	8
14,000	77	38	26	19	15	13	11	10
16,000	88	44	29	22	18	15	13	11
18,000	99	49	33	25	20	16	14	12
20,000	110	55	37	27	22	18	16	14
22,000	121	60	40	30	24	20	17	15
24,000	132	66	44	33	26	22	19	16
26,000	142	71	47	36	28	24	20	18
28,000	153	77	51	38	31	26	22	19
30,000	164	82	55	41	33	27	23	21
32,000	175	88	58	44	35	29	25	22
34,000	186	93	62	47	37	31	27	23
36,000	197	99	66	49	39	33	28	25
38,000	208	104	69	52	42	35	30	26
40,000	219	110	73	55	44	37	31	27
42,000	230	115	77	58	46	38	33	29
44,000	241	121	80	60	48	40	34	30
46,000	252	126	84	63	50	42	36	32
48,000	263	132	88	66	53	44	38	33
50,000	274	137	91	68	55	46	39	34
52,000	285	142	95	71	57	47	41	36
54,000	296	148	99	74	59	49	42	37
56,000	307	153	102	77	61	51	44	38
58,000	318	159	106	79	64	53	45	40
60,000	329	164	110	82	66	55	47	41
62,000	340	170	113	85	68	57	49	42
64,000	351	175	117	88	70	58	50	44
66,000	362	181	121	90	72	60	52	45
68,000	373	186	124	93	75	62	53	47
70,000	384	192	128	96	77	64	55	48
72,000	395	197	132	99	79	66	56	49
75,000	411	205	137	103	82	68	59	51
80,000	438	219	146	110	88	73	63	55
85,000	466	233	155	116	93	78	67	58
90,000	493	247	164	123	99	82	70	62
95,000	521	260	174	130	104	87	74	65
100,000	548	274	183	137	110	91	78	68

**The state water use planning goal for Massachusetts is 65 GPCD.*

Save Water! Save Money!

Get Valuable Rebates

for installing

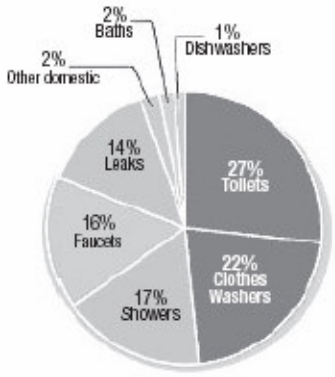
High-Efficiency Toilets

and

Washing Machines

Sharon Water Department
and
Water Management Advisory Committee

Toilets and clothes washers are the top two indoor water guzzlers in a typical home*:



High-efficiency toilets and front load clothes washers help keep your water use under **65 GPCD** (see the handy GPCD lookup table on the reverse to find out your water use). Thanks to innovative engineering, they also function better than older models.

*Source: American Water Works Association and AWWA Research Foundation

TOILET TIPS

- Install advanced High Efficiency Toilets (HETs) that average less than 1.3 gallons per flush. HETs are powerful and less prone to overflow. HETs may save 15,000 gallons per year compared to old 3.5 gallon models.
- Avoid flushing the toilet when not absolutely necessary, and don't use your toilet as a wastebasket.
- Toilet leaks cause high water bills. Check for toilet leaks by putting food coloring in your toilet tank. Do not flush. If dye appears in the bowl within 10-15 minutes, check the flapper in your toilet tank to see if it has deteriorated and needs to be replaced.
- Don't put strong cleaning chemicals in your toilet tank. They may corrode the rubber and plastic parts in your toilet tank and cause leaks.

FRONT LOAD WASHERS

Front load washing machines use less than 15 gallons per load, far less than the 35 to 50 gallons per load used by older top load models, and may save 10,000 gallons per year.

Front-load washing machines:

- Conserve heated water and lower your energy bills.
- Wring out more moisture in the spin cycle, reducing drying time and energy costs.
- Decrease wear on clothes so they last longer.
- Require less detergent.
- Help extend the life of your septic system.

APPENDIX D: TABLES AND FIGURES

Table 1. Average indoor water use in nonconserving and conserving North American single-family homes.

Water Use Type	**Nonconserving Home***	**Conserving Home - 2001***	**Conserving Home - 2005****	**Nonconserving Home**	**Conserving Home - 2001**	**Conserving Home - 2005**
Units	*Average gpcd*	*Average gpcd*	*Average gpcd*	*Percent of total*	*Percent of total*	*Percent of total*
Dishwasher	1	0.7	0.7	1.4%	1.5%	1.9%
Baths	1.2	1.2	1.2	1.7%	2.7%	3.3%
Leaks	9.5	4	4.0	13.7%	8.8%	11.0%
Faucets	10.9	10.8	10.8	15.7%	23.9%	29.8%
Showers	11.6	8.8	7.0	16.8%	19.5%	19.4%
Clothes Washer	15	10	5.2	21.7%	22.1%	14.3%
Toilets	18.5	8.2	5.6	26.7%	18.0%	15.6%
Other Domestic	1.6	1.6	1.6	2.2%	3.4%	4.4%
TOTAL	**69.3 gpcd**	**45.2 gpcd**	**36.2 gpcd**	100%	100%	100%

**Source: Vickers, 2001 (Adapted from Mayer et al, 1999)*

***Substituting 1.1 gpf High Efficiency Toilets, a 14 gpl front-load washing machine, and 2.0 gpm showerheads for Vickers' 1.6 gpf toilets, 27 gpl washing machine and 2.5 gpm showerheads*
gpcd = gallons per capita daily, gpf=gallons per flush, gpl=gallons per load, and gpm=gallons per minute

Table 2. Federal and Massachusetts maximum water-use requirements for plumbing fixtures and selected appliances.

Fixture or Appliance	Conservation Standard	Reference
Toilet, gravity tank	1.6 gpf	U.S. Energy Policy Act, 1992 (EPAct)
Urinals, any type	1.0 gpf	EPAct
Showerheads, any type (except those used for safety reasons)	2.5 gpm (at 80 psi) or 2.2 gpm (at 60 psi)	EPAct, MA Plumbing Code
Lavatory faucets and replacement aerators	2.5 gpm (at 80 psi) or 2.2 gpm (at 60 psi)	EPAct, MA Plumbing Code
Kitchen faucets and replacement aerators		EPAct, MA Plumbing Code
Dishwashers	4.5 gpl	National Appliance Energy Conservation Act, Vickers
Clotheswashers	Water Factor of 9 or less, 27 gpl	National Appliance Energy Conservation Act, Vickers

gpf = gallons per flush
gpm = gallons per minute
psi = pounds per square inch
gpc = gallons per cycle
gpl = gallons per load

Water Factor = a measure of the gallons of water used per cycle per cubic foot
Source: Adapted from Vickers, 2001

Table 3. Summary of Water Conservation Recommendations for Lawns and Landscapes

Lawn and Landscape Components	Care and Maintenance Components	Water Conservation Recommendations	References for More Information
GRASS	Size of Grass Area	Minimize lawn size and maintain existing native vegetation.	See 1, 2, 3, 4
	Grass Species	Use drought resistant/low-water use grass species (preferably native).	
	Grass Height	Mow lawns at the highest recommended height (at least 2.5 to 3 inches).	
	Pest Control	Practice Integrated Pest Management.	
	Fertilizing Grass	Don't fertlize unless recommended by a soil test. Don't fertilize in the summer. New growth requires more water. If fertilizer is needed, apply in early spring and/or fall and use organic fertilizer.	
SOILS	Soil Health	Ensure adequate depth and type of soil (at least 6 inches of good topsoil).	See 1, 4, 5
	Soil Moisture	Test soil for dryness. Water only when the soil is dry to a depth of 1.5 inches. Make sure the water soaks down 3-4 inches. This encourages deep root growth.	
PLANTS	Plant Species	Choose Native and Low Water-Use Plant Species.	See 1, 2, 3, 5
	Mulch	Use mulch. Mulch to keep roots cool and moist. Be careful not to apply too much, b/c the soil does require some heat.	
WATERING	How much water?	Massachusetts generally has enough rainfall to naturally supply the water needs of most healthy mature lawns *without the need for watering*. To maximize water conservation, limit watering to once a week for thirty minutes if needed (stop watering if pooling occurs).	See 1, 2, 3, 5, 6
	When to water	Between sunset and early morning. Avoid watering at night if disease is present, and avoid watering on windy days.	
	How to water	Water slowly and deeply. Avoid pooling (runoff).	
	Rainwater	Collect rainwater for landscaping needs. Use rain barrels and/or build a rain garden.	
AUTOMATIC IRRIGATION SYSTEMS	Climate-based Controllers	Adjust your watering schedule to track weather conditions at least once or twice a month.	See 3, 4, 6
	Rain Shut-off	Install a rain shut-off device to prevent watering if it rains	
	Maintenance	Inspect your system a few times during the watering season while it is running. Look for and repair leaking or broken sprinklers, and reposition those that spray unintended areas.	
	Testing	Hire an irrigation professional to test and adjust your system annually.	
	System settings	The best setting for irrigation systems is "off". Keep your system on manual and turn it on only when needed.	
REFERENCES			

1) *A Homeowners Guide to Environmentally Friendly Lawncare*, MA Department of Agricultural Resources, 1997

2) *More Than Just A Yard, Ecological Landscaping Tools for Massachusetts Homeowners*, Executive Office of Environmental Affiars, 2004

3) *Handbook of Water Use and Conservation*, Amy Vickers, 2001

4) *Guide to Lawn and Landscape Water Conservation*, MA Water Resources Commission, 2002

5) *Outdoor Water Conservation- Tips for Gardening and Landscaping*, Massachusetts Water Resources Authority, 2005

6) *2005 Greenscapes Reference Guide*, North South Rivers Watershed Association, 2005

APPENDIX E: RESIDENTIAL WATER USE DATA AND BENCHMARKS

The following discussion presents residential water use numbers including state, national and international data to provide the reader with some context and background for how the residential water use efficiency benchmarks were developed.

The amount of water consumed by a residential population is commonly used as a benchmark to evaluate the success of water conservation efforts. Water use is typically measured in gallons, and reported as gallons per capita per day (gpcd) that includes indoor and outdoor water use for a single residence. Measured and estimated numbers for residential gpcd vary throughout the state, the country and the world. In a survey of average combined indoor and outdoor residential water use for 13 cities and the United Kingdom, Vickers reports a low of below 50 gpcd for Cairo, Egypt and the United Kingdom, and a high of over 200 gpcd for Phoenix, Arizona and Las Virgenes, California.

Data considered in developing and evaluating benchmarks for efficient residential water use are presented below, along with several theoretical water budget scenarios.

Note: all numbers are residential gallons per capita per day (rgpcd) unless otherwise noted

Indoor Water Use

- Vickers[1]: US avg. = 69
- REUWS[2]: 12 cities, 1,188 homes, predominantly west and southwest
  Avg. = 60
- NAREUS[3]: 12 cities, 12,000 houses, diversity of homes, predominantly west and southwest
  Avg. = 62
- Maddaus[4]: US Avg. = 60
- MA Title 5 wastewater modeling assumptions[5]: Avg. wastewater flow = 55
- Seattle Home Water Conservation Study[6]: Avg. = 45
- ***Range: 45 to 69***

Comments: Indoor water use does not vary significantly over the year or across the country and continues to go down on average.

Outdoor Water Use

- Vickers: US avg. = 32
- REUWS: Avg. = 101
- NAREUS: Avg. = 86
- Waterloo Canada, NAREUS: 25.3 summer average (the study states that this data point is representative of conditions in the northeast part of North America)
- Full Conservation: close to zero
- ***Range: zero to 101***

Comments: Outdoor water use varies significantly over the year and across the country and has been going up on average. In New England, outdoor water use during the months of May through September typically increases by approximately 25-50% over base indoor use from November through March.

Theoretical Water Budget Scenarios

Following are some residential water use scenarios that were considered in developing annual rgpcd benchmarks:

Scenario 1: Full Conservation 2005
Assumes fully conserving fixtures and appliances available in 2005 for indoor use, and 25% increase over base for outdoor use

Assume 36 for indoor (months of October through April)
Assume 45 during the months of May through September (36 indoor + 25% increase over base)
Annual avg. = 40 gpcd

Scenario 2: Full Conservation 2001
Vickers' conserving household numbers published in 2001 for indoor use, and 25% increase over base for outdoor use

Assume 45 for indoor (months of October through April)
Assume 56 during the months of May through September (45 indoor + 25% increase over base)
Annual avg. = 50 gpcd

Scenario 3: Massachusetts Average
MA Title 5 numbers for indoor use and 50% increase over base for outdoor use

Assume 55 for indoor (months of October through April)
Assume 82.5 during the months of May through September (55 indoor + 50% increase over base)
Annual avg. = 66 gpcd

Scenario 4: US Average
Vickers numbers for average indoor use and 50% increase over base for outdoor use

Assume 69 for indoor (months of October through April)
Assume 104 during the months of May through September (69 indoor + 50% increase over base)
Annual avg. = 84 gpcd

Status of MA Communities in relation to MassDEP benchmarks of 65 and 80 rgpcd

MassDEP, 2003 ASRs[7], 187 communities with data
- 42 communities or 23% are above 80 rgpcd
- 62 communities or 33% are between 65 and 80 rgpcd
- 83 communities or 44% are below 65 rgpcd

Massachusetts Water Resources Authority (MWRA), 2003, 29 communities with data
- 6 communities or 21% are above 80
- 13 communities or 45% are between 65 and 80
- 10 communities or 34% are below 65

Sources (see References for full citations)

1. Amy Vickers "Handbook of Water Use and Conservation", 2001
2. Mayer et al. 1999. Residential End Uses of Water Study (REUWS)
3. Mayer et al. 2000. North American Residential End Use Study (NAREUS)
4. Maddaus, W.O. Water Conservation. American Water Works Association. Denver, CO. 1987
5. Technical Evaluation – Title 5, DeFeo, Wait & Associates, Inc.
6. Seattle Home Water Conservation Study, 2000
7. MassDEP Public Water Supply Annual Statistical Report Data, 1999, 2002, 2003

APPENDIX F: BMPS FOR SELECTED INDUSTRIES[13]

Water consumption in the Semiconductor, Metal Plating, Printed Circuit Boards, Paper and Rubbers and Plastics industries is quite high. Knowledge of water balance for the entire facility and specifications for each stream are useful for a program on water conservation. Simple engineering systems such as countercurrent flows, high pressure low volume atomized or fog spray rinsing systems, tying dumping of baths to measurement of critical bath parameters, installing essential instrumentation (e.g. flow restrictors, conductivity controllers, pH meters, etc.) and installing filtration/screening and cooling systems provide options to reclaim, refine and reuse water continuously.

- Water Conservation Plans (general)
- Semiconductors
- Metal Plating
- Printed Circuit Boards
- Paper
- Rubber and Plastics

WATER CONSERVATION PLANS (general)

Water is an important resource or raw material in the manufacturing of various products; however, for many facilities water is usually considered an overhead cost. In most municipalities in the Commonwealth of Massachusetts, facilities pay a contracted rate for the volume of water supplied and a sewer cost, typically at a higher and different rate. To appreciate the contribution of water to the operation of any plant, there should be a cost value assigned to its input, whether it is a reactant, a solvent, a cleaning agent, a convenient means to transport other resources, or a way to store intermediate or final products.

Controlling the use and cost of water is the responsibility of everybody in the company. A policy statement with clear objectives that is supported by top management will define the company's position on water use. The objectives serve as guidelines to develop goals that all employees can work towards. Included in this policy, a management team should be established and a continuous program for educating employees should be implemented.

The management team monitors the use of water in the facility and to formulate an equitable means of allocating cost to the use of water and its disposal. For a small facility, these responsibilities maybe assigned to an individual with the additional authority to enforce viable and cost-effective changes.

Basic Program

Outlined below are some simple, practical and general measures and procedures that may promote water conservation and optimal uses in some industry sectors. The list is by no means exhaustive. The peculiarities of an individual facility may make some of the suggestions impractical - ideally, such peculiarities should be viewed as opportunities to develop viable alternatives.

Water Balance

Measurements should be taken to establish a water balance for all operations. Inputs and effluents from all

[13] Best Management Practices for Selected Industries and Additional Resources. Gus Ogunbameru, PhD. Ch. E. - Massachusetts Office of Technical Assistance. For more information, see http://www.mass.gov/envir/ota/resources/water_conserv.htm

processes should be assessed. The flow of water to all points of input and effluent for all process steps should be measured, documented and continuously monitored. Water meters may be installed for major consumers. Simple methods to estimate flow rates, e.g. using a bucket and a timer, can be adequate to get reasonable flow rates. Flow rates should be determined for all flows using appropriately sized flow meters, where possible. The flow rates should be compared to plant design specifications, and used as a baseline against which the success of any water conservation scheme may be measured. Flows to plants and equipment should be kept to the rates specified by the equipment manufacturers.

Cost Centers
A realistic cost value based on volumes used should be assessed to all process steps. Major consumers may be considered cost centers and the cost to supply water and to dispose of wastewater should be documented regularly.

Monitor and Audit
At established periodic intervals, flow rates should be measured and compared with those established through the water balance.

Maintenance
All fresh water and wastewater leaks should be logged on a daily basis. Maintenance should be carried out to fix leaks within 24 hours of their discovery.

Energy Savings
In many operations, energy savings will be realized at the same time that water conservation is implemented.

For further information on BMPs in each of the following industrial sectors, please visit the OTA website at, http://www.mass.gov/envir/ota/resources/water_conserv.htm

- Semiconductors
- Metal Plating
- Printed Circuit Boards
- Paper Mills
- Rubber and Plastics

APPENDIX G: WATER CONSERVATION COORDINATOR JOB DESCRIPTION

Water conservation coordinators, an entity commonly found in the West and other places frequently plagued with drought conditions. Here in the New England, however, one would be hard pressed to find a water conservation coordinator – even in a large utility.

Some public water suppliers may not see the need to employ a water conservation coordinator. Water is plentiful most times of the year; if demand gets too high in the summer mandatory restrictions on outdoor water use is usually an effective way to deal with the problem.

However, reacting to emergency situations is not in the long term best interests of the utility and could lead to poor relations with customers. Responsible water suppliers manage water demand to ensure little is wasted and there are adequate supplies to drink and for fire safety, at the same time not restricting customers' use. One way to achieve this goal is to create and implement a comprehensive water conservation program that addresses residential, institutional and commercial users.

Public Water Suppliers seriously interested in implementing a comprehensive water conservation effort should consider hiring an individual to create and carry out various programs. While some water conservation activities can be added to existing staffs' duties, a program is more likely to succeed when staff is hired specifically to implement conservation programs because:

- A coordinator's sole focus is reducing water use in the community. He or she is able to methodically plan and carry out a water conservation program without the distractions and/or demands of other duties.
- Existing staff may not have the desired skill set of a coordinator

In regards to funding the position, there are several models water suppliers could consider. A large utility may find it necessary to hire at least one full-time person. In other parts of the country, water suppliers have a staff of water conservation specialists. Smaller utilities can hire someone on a part time basis or even share a person among two or three towns.

Typical job duties of a water conservation coordinator include:

- Establish water conservation goals
- Develop water conservation program
- Identifies and assesses conservation incentives appropriate for implementation
- Analyzes costs and benefits to water conservation program
- Studies various rate structures to encourage conservation
- Answers public inquiries
- Coordinates with state and federal government
- Creates and implements promotional and marketing campaign aimed at achieving water conservation program goals
- Assists residential, commercial and institutional customers in conserving water
- Administer and enforces local water regulations and restrictions
- Designs and writes water conservation outreach material, including letters to the editor, bill inserts, brochures and web site content
- Conducts presentations a various forums including stakeholder groups, schools, clubs and business associations

APPENDIX H: SAMPLE WORKSHEET FOR INDUSTRIAL / COMMERCIAL / INSTITUTIONAL WATER AUDIT[14]

AUDIT COMPLETED BY (NAME):

GENERAL INFORMATION

Customer/Account Name:
Address:
Facility contact person:
Product(s) or services(s):

SIC category(ies)

Facility dimensions (for each building) in sq ft:		No. floors	Width	Height	Age of facility(years)
Avg. no. of occupants (employees and nonemployees):		Female:	Male	Total	
Avg. no. of days facility occupied/year	Avg. no. hours occupied/day:		Weekdays	Weekends	Holidays
Is recycled water currently used on site?		Yes No	If yes, describe and give amount used (e.g. gallons per year):		
Building wastewater is:	Treated on site	Connected to municipal/off-site system		Other (describe)	

METER INFORMATION

	Meter No. 1 ID No.	**Meter No. 2 ID No.**	**Meter No. 3 ID No.**	**Meter No. 4 ID No.**	**Meter No. 5 ID No.**
Meter location					
Meter type					
Reading frequency					
Units of register					
Multiplier (if any)					
Meter size					
Connection size					
Meter installation date					
Testing frequency					
Last service (date)					
Last test/calibration (dates)					

[14] Source: Amy Vickers, 2001